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MAR 21 1984

MEMORANDUM

To: AWR - (Refuge Supervisors)
From: Regional Hydrologist, Region 6
Subject: Annual Water Use Report/Management Plans

Please extend our thanks to the Refuge Managers for the timely submission of their 1983 Water Use Reports and 1984 Management Plans.

The following reports have been reviewed and found to be an informative documentation of refuge water use:

Upper Souris NWR	ND
Sand Lake NWR	SD
Pocasse NWR	SD
Waubay NWR	SD
Alamosa/Monte Vista NWR	CO
✓ Medicine Lake NWR	MT

Robert E Green

bcc: Circ rf (2)

EN:Chesy:mk:3/20/84

Rec'd
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MEDICINE LAKE NATIONAL WILDLIFE REFUGE

MEDICINE LAKE, MONTANA

ANNUAL WATER MANAGEMENT PLAN

1983 Water Use Data
1984 Recommendations

UNITED STATES DEPARTMENT OF INTERIOR
FISH AND WILDLIFE SERVICE

USFWS

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MEDICINE LAKE NATIONAL WILDLIFE REFUGE

MEDICINE LAKE, MONTANA

ANNUAL WATER MANAGEMENT PLAN - 1984

I. RECORD OF 1983 WATER USE

A. Source of Supply

The winter of 1982-83 was extremely mild and provided very little snowpack. The wet soil conditions in the late fall of 1982 resulted in a good frost seal which allowed what little spring water that was available to run off. From December 1982 through February 1983, only 11 inches of accumulated snow fell with .70 inches of actual precipitation. Spring run-off started in mid-February, several weeks earlier than normal, and ran through the end of April. This spring run-off was generally slow but steady. All drainages except Lake Creek provided some measurable flows. Spring run-off provided adequate flows to bring all impoundments, including Medicine Lake, up to operational levels. Sufficient water was available to allow some flushing action of all impoundments.

Heavy thunderstorms in mid-July provided some relatively heavy run-off for several weeks in the Sand Creek and Cottonwood Creek drainages.

Refuge wetlands were at acceptable water levels prior to spring run-off with only a water deficiency of 15,319 acre feet. The refuge recorded 33,681 acre feet of water inflows from tributary streams.

B. Type of Rights

Under the Montana Water Rights Adjudication Law, all water rights filed prior to 1973 had to be refiled before April 15, 1982. The refuge water rights were researched and filed by the Regional Office engineering water resources section. A filing of 30 different water rights totaling 146,715 acre feet of water was made prior to the deadline.

The legal process now requires water courts to review all claims in Montana and issue preliminary decrees. Claimants will then have the opportunity for objections and appeals before final water decrees are issued. This very lengthy process could drag on for many years before the refuge receives the final decrees.

C. Purpose of Use

Diverted water was used for storage in impoundments, lakes and marshes. This stored water is used primarily for waterfowl habitat. The habitat provided also benefits marsh and water birds, shorebirds, gulls, terns and raptorial birds. Secondary benefits are provided to the fisheries resource and resident game.

Diverted water in excess of storage needs was permitted to circulate through the system and provided a flushing action. This flushing is very important to

allow accumulated salts, resulting from evaporation, to be washed out.

All wells and ponds were used for wildlife, livestock and domestic purposes.

D. Season of Use

The main season of water use is from mid-March until early December. Adequate water supplies are especially critical from mid-March to late July for waterfowl pairing and brooding habitat. Another important period of water use is mid-September to mid-November for migrational habitat for waterfowl.

The lakes and marshes are generally ice covered from early December through the end of March. Adequate water levels are necessary in winter to carry over resident fish and aquatic invertebrate populations.

The main well at headquarters is used year round for domestic purposes. The secondary well at headquarters is used for irrigation of lawns and gardens from mid-May until early September.

The pumped wells in the sandhills are used for wildlife and livestock watering. This use occurs between May 1 and November 1.

E. Quantity Used

A total of 33,681 acre feet of water was measured entering the refuge via creek channels during spring and summer run-off.

Using the deficit figure of 15,319 acre feet prior to spring run-off and the total 33,681 acre feet of water diverted, there was approximately 18,362 acre feet of water that circulated through the refuge water system prior to being released into Big Muddy Creek.

A water release from Homestead Lake was started on June 27 (guage reading 1936.28 feet MSL) and continued through August 1 (guage reading 1934.15 feet MSL). This release of 2615 acre feet resulted in a 2.13 foot drop in water levels. This release was scheduled to help alleviate the hazard and severity of avian botulism on this impoundment.

In order to provide fall migrational habitat for waterfowl on Medicine Lake, water was released from the Medicine Lake outlet structure No. 4, between September 16 and 20. This resulted in a drop of .45 feet in Medicine Lake (elevation 1942.35 to 1941.90 feet MSL) with about 3,778 acre feet being diverted into Homestead Lake, bringing the water elevation up to 1934.46 feet MSL in this unit.

Between November 14 and December 1, after ice-up, water was released from Homestead Lake into Big Muddy Creek. This one foot drop in the water level of this impoundment resulted in 1228 acre feet of water being released and lowered Homestead Lake to an elevation of 1933.6 feet MSL. This was accomplished in an effort to winter kill the lake's carp population.

An estimated 20 acre feet of water was pumped from the four refuge wells.

TABLE I. MAJOR IMPOUNMENT WATER DEFICIT, JANUARY 1, 1984

Name of Lake	Elevation Jan. 1, 1984	Operating Elevation	Elevation Difference	Acre Ft. Deficit	Surface acres at operational level
Homestead Lake	1933.60	1937.65	-4.05	4973.4	1228.0
Gaffney Lake	1943.90	1945.00	-1.10	708.8	644.4
#10 Lake	1944.60	1945.80	-1.20	319.2	266.0
Deep Lake	1943.30	1945.80	-2.50	249.0	99.6
Long Lake	1943.90	1945.00	-1.10	76.1	69.2
#11 Lake	1951.00*	1953.00	-2.00	382.4	191.2
#12 Lake	1953.90	1956.00	-2.10	1006.3	479.2
Katy's Lake	1952.00	1954.40	-2.40	748.8	312.0
Medicine Lake	1941.80	1943.02	-1.22	10241.7	8394.8
Sayer Bay	1941.80	1944.00**	-2.20	374.0	170.0
Total				19079.7	11854.4

* Estimated only-water guage not installed.

** Suggested level for 1984

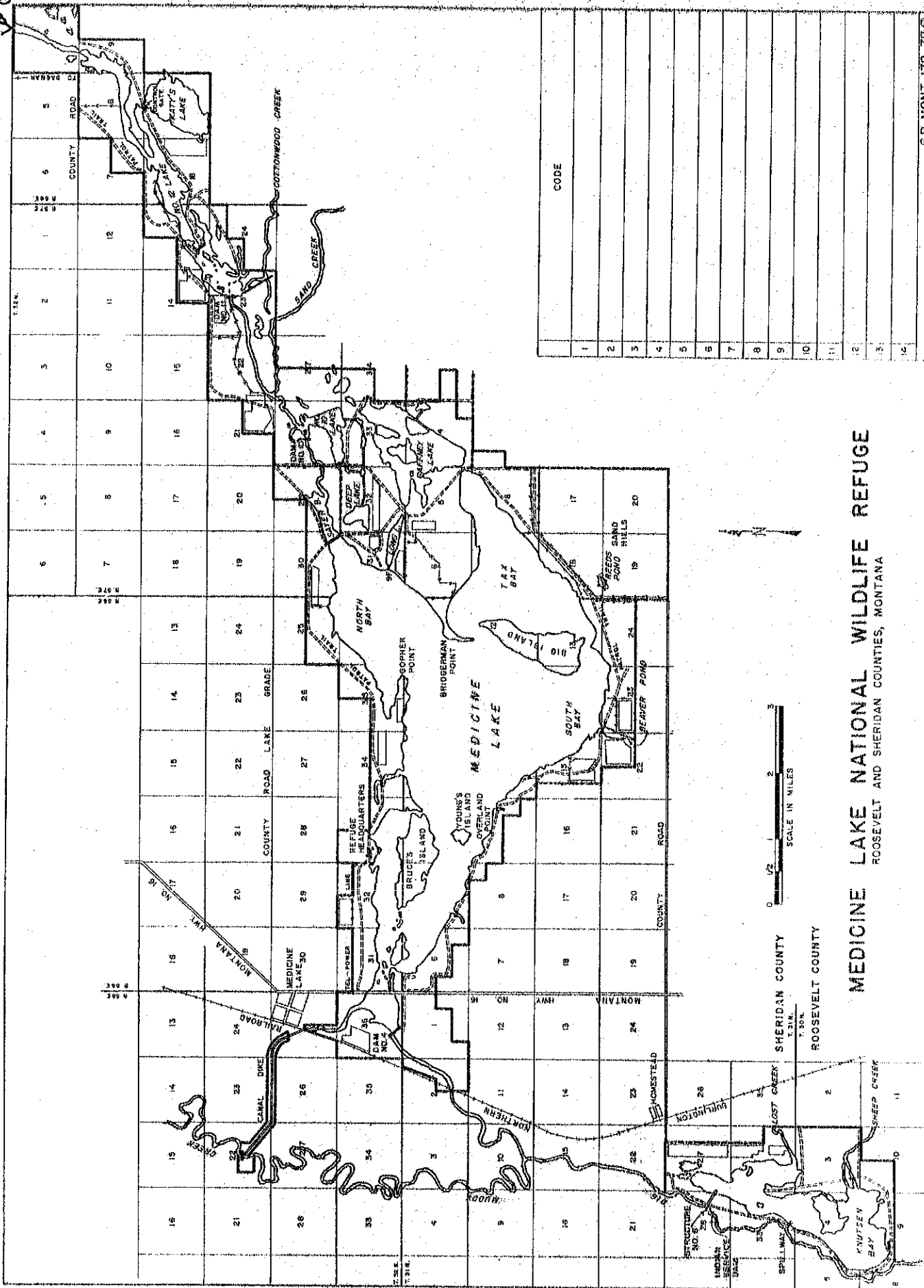
TABLE II. COMPARISON OF WATER DEFICIENCIES *

Impoundment	Acre Feet of Water Needed								
	1984	1983	1982	1981	1980	1979	1978	1977	1976
Homestead Lake	4973	3352	5993	4298	2028	4199	2648	2002	1589
Gaffney's Lake	709	516	3022	2442	547	214	842	641	0
#10 Lake	319	106	356	266	23	23	97	131	0
Deep Lake	249	159	287	403	34	23	57	52	0
Long Lake	76	55	377	291	76	30	149	89	0
#11 Lake	382	153	402	405	288	174	462	307	250
#12 Lake	1006	455	1198	729	620	286	1324	968	1785
Katy's Lake	749	281	705	661	334	183	330	484	325
Medicine Lake	10242	10242	29969	23002	11921	5205	19980	9738	3862
Sayer Bay	374								
TOTAL	19080	15319	42309	32497	15871	10337	25898	14412	7811

* Deficiencies based on water elevation on January 1 of each year.

TABLE III. MAJOR IMPOUNDMENT WATER DEFICIENCIES AND SUPPLY SOURCE

AREA	Deficiency in Acre Feet		Tributary Stream
	Spring of 1983	Fall of 1983	
Homestead Lake	3352	4973	Big Muddy Creek Lost Creek Sheep Creek
Gaffney Lake	516	709	Cottonwood Creek Lake Creek Sand Creek
#10 Lake	106	319	Cottonwood Creek Lake Creek Sand Creek
Deep Lake	159	249	Cottonwood Creek Lake Creek Sand Creek
Long Lake	55	76	Cottonwood Creek Lake Creek Sand Creek
#11 Lake	153	382	Cottonwood Creek Lake Creek Sand Creek
#12 Lake	455	1006	Lake Creek
Katy's Lake	281	749	Lake Creek
Sayer Bay		374	Lake Creek
Medicine Lake	10242	10242	Big Muddy Creek Lake Creek
Total	15319	19080	



MEDICINE LAKE NATIONAL WILDLIFE REFUGE
ROOSEVELT AND SHERIDAN COUNTIES, MONTANA

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F. Place of Use

TABLE III compares the deficiency of each major impoundment between 1982 and 1983. This table also lists the tributary streams which supply water to each impoundment.

G. Adequacy of Supply

Sufficient spring run-off allowed all impoundments to reach operational levels. Adequate water was available to provide some flushing action of all impoundments.

TABLE IV. WATER RECEIVED PER TRIBUTARY STREAM - 1983

<u>Tributary Source</u>	<u>Acre Feet of Water Diverted</u>
Muddy Creek	20,875
Lost Creek	329
Sheep Creek	755
Sand Creek	2,812
Cottonwood Creek	8,910
Lake Creek	0
<hr/>	
Total	33,681 Acre Feet

The total recorded precipitation at refuge headquarters for 1983 was only 8.15 inches which was 6.03 inches below the normal of 14.18 inches. This is a 57% decrease from normal. Two thunderstorms in mid-July resulted in over 2 inches of precipitation. This did provide run-off in Cottonwood and Sand Creeks..

TABLE V. ANNUAL PRECIPITATION AMOUNTS (INCHES)

Month	<u>1983</u>		<u>1982</u>		Normal Precipitation
	Total Precipitation	Snowfall	Total Precipitation	Snowfall	
January	.12	1.0	1.47	29.0	.43
February	Trace	0	.61	6.0	.39
March	.60	5.0	1.31	13.0	.37
April	.16		.90	2.0	1.24
May	1.42	11.0	2.56		1.78
June	.07		2.62		3.45
July	2.98		1.80		2.12
August	.65		1.53		1.68
September	1.48		1.57		1.17
October	.09		1.20		.71
November	.27	1.0	.01		.51
December	.31	3.0	.48	9.0	.33
TOTAL	8.15	21.0	16.06	59.0	14.18

TABLE VI. MONTHLY RECORD OF GUAGE READINGS - 1983

IMPOUNDMENT OPERATIONAL LEVEL**	Homestead Lake	Gaffney Lake	#10 Lake	Deep Lake	Long Lake	#11 Lake	#12 Lake	Katy's Lake	Medicine Lake Lake
January	1937.65	1945.00	1945.80	1946.20	1945.00	1953.00	1956.00	1954.40	1943.02
February	1934.92	1944.20	1945.40	1944.60	1944.20	1952.20	1955.20	1953.50	1941.80
March	1934.80	1944.60	1946.45	1945.00	1944.60	*Spilling	1955.00	1953.60	1942.35
April	1935.90	1945.30	1946.50	1946.40	1945.30	*Spilling	1955.30	1953.70	1943.20
May	1937.90	1946.0	1946.00	1945.90	1946.00	*Spilling	1956.05	1953.75	1944.30
June	1937.30	*	1945.90	1945.80	*	*Spilling	1956.40	*	1943.80
July	1936.40	1945.30	1945.75	1945.30	1945.30	*Spilling	1956.15	1953.50	1943.60
August	1935.50	1944.90	1945.30	1944.70	1944.90	*	1955.50	1952.10	1943.20
September	1934.30	1945.20	1945.15	1944.45	1945.20	*	1955.00	1952.80	1942.92
October	**	1944.40	1944.50	**	1944.40	*	1954.20	1952.20	1942.35
November	1934.90	1944.20	1944.50	**	1944.20	*	1954.10	1952.10	1941.95
December	1934.70	1944.00	1944.60	**	1944.00	*	1953.90	1952.10	1941.85
	1933.60	1943.90	1944.60	**	1943.90	*	1953.90	1952.00	1941.80

* Not available - guage not operational

** Not available - water level below guage

*** It should be noted that although these operational levels may be different than previous plans (Prior to 1980), it is because they had been recalculated in 1981 to correct MSL readings. It was found that many of the guages were correctly set. The approved actual water levels remained unchanged.

H. Improvements to Water Facilities During 1983

The Sheep Creek Dam #2 (Breeser Dam), on the Homestead Unit, was functionally completed in 1982. Due to the dike settling and some minor erosion during the summer of 1983, this dike required additional fill to bring it up to grade and additional riprap placement was also required on the west side. The riser tube was reset in the fall of 1983 in order to bring it to an elevation which would provide complete drawdown capabilities. Spring run-off did fill this impoundment and created an attractive marsh, however, the impoundment was drawn down in early summer to permit required construction work and to decrease erosion damage. This new impoundment will create a 60 acre marsh.

The Sayer Bay Dam was finally completed in the fall of 1983. The construction of this dam was initially started under contract in 1981, received only minor work in 1982, and was completed in 1983 by a second contractor. Other than force account riprap work which is scheduled for February of 1984, this dam is functional. Water from the 1984 spring run-off will create a new permanent 170 acre marsh on the Sayer Bay arm of Medicine Lake.

I. Effects of Previous Years' Objectives

All major impoundments were filled as early as possible with available spring run-off. This adequate supply of water provided ideal breeding pair and brood habitat. The total duck pairs and resulting production remained very close to that of 1982.

Spring run-off provided enough water flows to allow limited flushing action in all impoundments. The 1983 quality was similar to previous years. Fall water chemistry readings showed some variance when compared to the fall of 1982. Katy's Lake increased .75 parts per 1,000 in salinity and increased 400 micromhos/centimeter over 1982. This is probably due to the lower fall water level resulting in higher concentrations of dissolved minerals. Katy's Lake is the one lake that does not have flushing capabilities. Deep Lake also showed some increase in fall salinity (up .5 parts/1000) and conductivity (up 475 micromho/centimeter) from 1982. This increase can also be attributed to very low fall water levels.

Medicine Lake was filled primarily from water diverted from Big Muddy Creek. By mid-March the lake had reached the operational level of 1943.02 feet MSL and exceeded this planned level in mid-April when it reached 1944.30 feet. These levels of water, provide good waterfowl pairing habitat along the shoreline. This level also maintained water in the emergent vegetation stands west of Highway #16 and in the upper reaches of Sayer Bay. This provided secure nesting sites for over water nesters, such as western grebes and diver ducks.

The high water level in Medicine Lake provided good spawning habitat for the northern pike population. The levels remained high enough through mid-summer to allow good egg hatching conditions and fry development.

Water levels on Medicine Lake remained high enough into late fall to provide adequate over-wintering habitat for the fisheries resource.

With construction work planned for late summer on Sayer Bay Dam, it was recommended not to exceed the operational level of 1943.02 feet on Medicine Lake and to allow the lake level to recede to 1942.0 by July 1. The lake level did reach 1944.30 on April 6 and gradually receded to 1943.20 by July 1, which was higher than recommended. At the time construction started in early September the lake had receded to 1942.35 which was adequate to allow completion of coffer dams around the Sayer Bay structure.

On April 22, Big Muddy Creek diversion (structure #1) was closed in order to keep any heavily silt laden summer run-off from entering Medicine Lake. Late spring lake levels were adequate and these potential silty waters were not needed. Closing the structure was a protective measure even though no heavy summer run-off occurred.

Spring run-off filled Homestead Lake as planned. Adequate flows allowed good flushing action. At the planned operational level of 1937.65 feet MSL, adequate water was available to provide over water nesting habitat and secure nesting islands.

As recommended, water was released from Homestead Lake starting June 27. This release was scheduled to bring the lake elevation to 1934.0 by August 1 in an attempt to alleviate a botulism outbreak. This release was discontinued on August 1 with a level of 1934.30 feet. This level proved adequate to remove all waters from the emergent vegetation. This management practice seemed to work well with only 63 ducks being picked up from loss to avian botulism compared with 3,780 ducks cleaned up in 1982 with no drawn down.

The mid-September water release from Medicine Lake to Homestead Lake worked well to provide fall waterfowl migrational habitat. The level of 1935.46 seemed to provide an ideal depth of water for waterfowl use. Plant growth which occurred on the mud flats was flooded with about 8-12 inches of water. However, for some reason waterfowl populations never reached the numbers found on this impoundment in the fall of 1982. Possibly by diverting water about 10 days earlier, September 6 rather than September 16, this area would become more attractive and hold additional earlier migrants.

Following the recommendation to release water from Homestead Lake after the fall migration, the structure was opened on November 14 and by December 1 the level had receded to 1933.6 feet (.4 feet lower than planned). At this level a winter kill of carp should take place during the winter of 1983 and 1984.

Heavy rainfall on July 9 and again on July 18 in the Cottonwood Creek and Sand Creek drainages, resulted in heavy run-off during this period. It had been recommended to maintain stable summer levels in #10 Lake and Gaffney Lake to minimize the chance of an avian botulism outbreak. Due to scheduled construction on Sayer Bay Dam this excess run-off could not be diverted into Medicine Lake. The #10 impoundment raised about one foot but was quickly lowered to its' previous level. This stable level seemed to prevent a serious botulism

problem. This excess water was diverted into Gaffney and Long Lake and resulted in a 1/2 foot increase in their water levels and they remained high throughout the summer. Gaffney Lake, possibly due to this quick raise in levels, had more diseased birds than in 1982. A total of 252 ducks were picked up on Gaffney Lake. 71 ducks were cleaned up from #10 Lake compared to 610 in 1982.

1983 SUMMARY

Water deficiency January 1, 1983	15,319 A/F
Total water diverted through the refuge 1983	33,681 A/F
Excess waters released into Muddy Creek 1983	18,362 A/F
Water released from Homestead Lake (summer drawdown 6/27/83 - 8/1/83)	2,615 A/F —
Water diverted from Medicine Lake to Homestead Lake (fall migrational habitat - 09/16/83-09/20/83)	3,778 A/F
Water released from Homestead Lake (winter drawdown -(11/14/83-12/01/83)	1,228 A/F —
Water deficiency on December 31, 1983	19,080 A/F

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1983 WATER FLOWS RECEIVED BY TRIBUTARY

Big Muddy Creek	20,875 A/F
Lost Creek	329 A/F
Sheep Creek	755 A/F
Sand Creek	2,812 A/F
Lake Creek	0 A/F
Cottonwood Creek	8,910 A/F

TABLE VII. 1983 - WATER CHEMISTRY INFORMATION ON TRIBUTARY STREAMS - Spring Flow

Location	Date	Temp. °C	Salinity Parts/1000	Conductivity Micromho/Cent.	Comments
Muddy Creek	02/22/83	0°	0	270	Early spring run-off
Muddy Creek	04/01/83	1°	0	330	
Cottonwood Creek	02/22/83	0°	0	190	Early spring run-off
Lake Creek		No flows			
Sand Creek	02/22/83	0°	.25	525	Early spring run-off
Sheep Creek	02/22/83	0°	1.25	1400	Early spring run-off
Lost Creek	02/24/83	0°	.25	80	Early spring run-off Taken from bridge north of Froid, MT.
#4 Spillway exiting Medicine Lake	04/01/83	2°	.25	410	Release over spillway

TABLE VIII. 1983 - WATER CHEMISTRY INFORMATION ON IMPOUNDMENTS - Spring *

Impoundment	Location	Temp. °C	Salinity Parts/1000	Conductivity Micromho/Cent.	Comments
Medicine Lake	1A	17°	1.0	1600	Bruce's Island narrows
Medicine Lake	1B	18°	1.0	1650	At shore by structure 9F
Gaffney Lake	2A	19°	1.0	1800	At shore by outlet
Gaffney Lake	2B	19°	1.0	1400	At shore by island canal
#10 Lake	3	21°	1.5	2300	By canal to Gaffney Lake
Deep Lake	4	18°	2.0	3000	At north shore
#12 Lake	5	17°	.5	1250	At structure #12
Katy's Lake	6	18°	2.25	3900	At shore by structure
#11 Lake	7	17°	1.00	1850	Below #12 structure
Homestead Lake	8A	17°	.50	1400	At canal between north lakes
Homestead Lake	8B	17°	.50	1250	At shore Lost Creek Bay

* Readings taken on June 7, 1983 following major run-off from tributary streams.

TABLE IX. 1983 - WATER CHEMISTRY INFORMATION ON IMPOUNDMENTS - Fall*

Impoundment	Location	Temp °C	Parts/1000	Micromho/Cent.	Comments
Medicine Lake	1A	1°	1.25	1300	Bruce's Island narrows
Medicine Lake	1B	1°	1.0	1300	100' out from 9F structur
Gaffney Lake	2A	0°	2.0	1200	100' from outlet canal
Gaffney Lake	2B	0°	1.25	1400	100' from island canal
#10 Lake	3	2°	1.50	1600	100' north of canal to Gaffney
Deep Lake	4	0°	2.5	2500	100' from north shore 15.
#12 Lake	5	2°	.75	1000	50' from structure
Katy's Lake	6	1°	3.75	3700	100 yds. from structure
#11 Lake	7	1°	2.0	2100	50' below #12 structure
Homestead Lake	8A	1.5°	1.5	1575	Canal between north lakes
Homestead Lake	8B	1.5°	1.5	1625	Taken 100' out from Lost Creek shore

* Readings taken on 11/28/83 through 3 inches of ice.

II. RECOMMENDATIONS AND OBJECTIVES FOR WATER MANAGEMENT IN 1984

A. General recommendations for all wetlands on the refuge are as follows.

1. Fill all refuge impoundments as early as possible to insure retaining all available flow from the spring run-off.
2. Fill all upper impoundments with waters from Lake Creek, Sand Creek and Cottonwood Creek before allowing these waters to enter Medicine Lake.
3. Provide for as much flushing action as possible with available spring and summer run-off. This will improve water qualities by reducing salinity.
4. Continue to collect water quality information by taking salinity and conductivity readings for all major water flows entering or being discharged from the refuge. Spring and late fall readings should be collected as in the past for all major impoundments. The collection of this data will document any changes in water quality occurring over the years.

TABLE X shows the priority of water use on the refuge. Priority I impoundments should be filled and maintained before priority II impoundments.

TABLE X. PROPOSED WATER USE PRIORITY

Unit	Purpose	Priority
#12 Lake	Nesting, brooding, storage, fish rearing	1
Katy's Lake	Nesting, brooding, storage	1
#11 Lake	Nesting, brooding, storage	1
#10 Lake	Nesting, brooding, storage	1
Gaffney Lake	Nesting, brooding, storage, fish rearing	2
Deep Lake	Nesting, brooding, storage	1
Long Lake	Nesting, brooding, storage	2
Sayer Bay	Nesting, brooding, storage, fish rearing	1
Medicine Lake	Nesting, brooding, storage, fish rearing	2
Homestead Lake	Nesting, brooding, storage	1
Sheep Creek	Nesting, brooding	1
Breaser Dam	Nesting, brooding	1

B. Specific Recommendations and Objectives For Individual Impoundments for 1984

1. Medicine Lake: The mid-winter water elevation is 1.22 feet below the operational level of 1943.02. This will require about 10,242 feet of water to meet management objectives. It is recommended to divert all available spring run-off from the Muddy Creek into Medicine Lake. If run-off exceeds the 10,242 acre feet, then it is recommended to allow the maximum level to reach an elevation of 1944.0. At this level, excess water will spill over the #4 spillway until slowly receding

to the 1943.02 level. When levels start to exceed the 1944.00 level, then the #4 structure should be opened to relieve pressure on the spillway.

If flows entering Homestead Lake are not sufficient to fill the lake, then water from Medicine Lake shall be released to provide what is required at Homestead.

Heavy silt laden waters of Big Muddy Creek, following heavy summer thunderstorms, will be kept from entering Medicine Lake using the new #1 structure on the diversion canal. This will alleviate sediment deposits on the west end of Medicine Lake. Medicine Lake water levels are high enough this year that the need for this silt laden waters should not be required.

By allowing Medicine Lake to reach an elevation of 1944.00 feet in the early spring and allowing it to recede to 1943.02 by early summer, the following objectives should be met.

- a. Waterfowl breeding pair habitat will be adequate. Water levels in emergent vegetation will provide nesting locations for over the water nesters including waterfowl, grebes and black-crowned night herons.
 - b. Natural islands will be secure and provide nesting sites for geese, pelicans, cormorants and great blue herons.
 - c. After normal water loss, due to evaporation and seepage, early fall water levels will be adequate to provide a water release to Homestead Lake for migrational habitat on Medicine Lake as well as adequate water depth for over-wintering fish.
 - d. This elevation will provide excellent early spring northern pike spawning habitat in the emergent vegetation stands west of Highway #16.
 - e. Erosion of islands and shorelines by wave action will not be excessive. This level has been commonly reached in past years without causing excessive damage.
2. Homestead Lake: The impoundment is 4.05 feet below its' operational water level of 1937.65 elevation and will require about 4,973 acre feet to fill the lake. It is recommended to divert all available flows of Sheep Creek, Lost Creek and Big Muddy Creek into this impoundment. If adequate flow is available, flushing should be accomplished by diverting and then releasing water through the #6 control structure. If flows are inadequate to reach the operational level, then water should be released from Medicine Lake to meet this need.

Objectives To Be Met In 1984

- a. Waterfowl breeding pair habitat will be optimum at spring operational level.

- b. Over water nesting sites in emergent vegetation for waterfowl, grebes and black-crowned night herons will be optimum at spring operational levels.
 - c. Constructed nesting islands will provide secure nesting sites geese and other waterfowl at spring operational levels.
 - d. Aquatic vegetation should flourish at spring operational levels in this relatively shallow impoundment.
 - e. To reduce the hazard and severity of avian botulism, the lake level will be drawn down beginning in late June. Volume of water release must be controlled to prevent flooding the access crossing to BIA hay fields downstream. The water level will be at 1936.00 elevation by July 1 and further reduced to an elevation of 1934.30 by August 1. At this level, water will be removed from the emergent shoreline vegetation stands which seem to contribute to the severe botulism outbreaks.
 - f. If water levels permit, a release of water from Medicine Lake in mid-September can be diverted into Homestead Lake to bring levels back up to 1935.50 elevation to provide adequate fall migrational habitat for waterfowl. This will require about 2,000 acre feet of water from Medicine Lake.
 - g. Water will again be released after fall migration is completed. By releasing water about November 1 and reducing the lake level to 1934.0 elevation, the carp population of the lake should be adequately reduced.
3. Lakes #10, #11, #12, Gaffney Lake and Log Lake: Water levels for this series of water units are all dependent on spring run-off flows from Cottonwood, Sand and Lake Creeks. Mid-winter water levels vary from 1.1 to 2.1 feet below operational levels. Upstream impoundments will be filled first, then each impoundment below. If flows are adequate, water control structures will be opened rather than relying on spillways. This provides the best flushing action and allows for the reduction accumulated salinity in these units.

Specific objectives to be met in 1984

- a. If spring run-off is adequate, all impoundments will be filled to operational levels as early as possible.
- b. If water reaches operational levels, breeding pair habitat for waterfowl will be maximized.
- c. At operational levels, constructed and natural nesting islands will remain secure and yet minimize erosion by wind and wave action.
- d. No water releases or drawdowns will be accomplished. By maintaining water levels as close to operational level as possible, brooding habitat will be optimum. After evaporation and loss to seepage, levels will remain adequate for fall migration.

- e. Lakes #10 and Gaffney have been historic sites for avian botulism. This outbreak can be minimized or the severity reduced by maintaining constant water levels. Rapid flooding of shallow areas following heavy summer rain storms seems to trigger outbreaks in these impoundments. Levels must remain constant following storms.

4. Katy's Lake and Deep Lake

These two natural sumps do not have outlets providing the option of flushing. These water bodies are the two most alkaline marshes on the refuge. Both marshes have water supplies provided by canals from water control structures.

Specific Objectives for 1984

- a. If spring water supplies are sufficient, both lakes will be filled to operational levels. This will maximize breeding pair and brooding habitat. At these water levels a good growth of aquatic vegetation will also be produced.
- b. Katy's Lake has had a history of avian botulism. Rapid raises in mid-summer water levels must be prevented to alleviate losses.

5. Sayer Bay

This is a new impoundment formed by the newly constructed Sayer Bay Dam. This impoundment should create approximately 170 acres of permanent marsh.

Specific Objectives for 1984

- a. This is a new dam with a rock gabion basket spillway elevation of 1946.0 feet. Providing there is not high spring run-off which would require use of the spillway, it is recommended that the water level does not exceed an elevation of 1944.0 feet. This would protect the dam from excessive erosion, allow it to stabilize and become vegetated.
- b. The stop log structure will be left completely open until spring flows begin to recede. This will allow northern pike from Medicine Lake to enter the impoundment and spawn in the emergent vegetation stands. This impoundment should provide excellent spawning and fish rearing habitat.
- c. In late fall the stop logs will be removed from the structure to allow the young northern pike to move into the deeper water of Medicine Lake for the winter. Without this release a winter kill on the fish in this impoundment might result.
- d. At the 1944.0 elevation the emergent vegetation stands should be adequately flooded to provide excellent over-water nesting habitat for waterfowl, grebes and black-crowned night herons.

- e. This bay has been subject to avian botulism in the past. Now that water levels are manageable, it is recommended to maintain a constant summer water level. Rapid flooding of shallow vegetated flats following summer thunderstorms could trigger an avian botulism outbreak.
- f. Monitoring of water quality will be started on this impoundment in 1984.